

## *CLAIMS*

1. An offset compensating device comprising:

a deviation monitor unit which generates a vector signal by A/D-converting the vector sum of the results of processings applied to two quadrature AC signals individually in response to an input signal and further quadrature-demodulating a result of the A/D-converting, and which monitors the deviation of the DC components superposed on the vector signal; and

an adaptive control unit which updates a compensation vector determined in advance, on the basis of an adaptive algorithm to minimize the expectation value of the product of the inner product between an increment vector indicating the increment of said deviation in the order of time series and the compensation vector, and the latest deviation vector indicating the deviation, and which adds the compensation vector to an offset vector to be inputted, while being superposed on said input signal, to a circuit to output said vector sum.

2. An offset compensating device comprising:

a deviation monitor unit which creates a vector signal by A/D-converting the vector sum of the results of processings applied to two quadrature AC signals individually in response to an input signal and by quadrature-demodulating and which monitors the deviation of the DC components superposed on the vector signal; and

an adaptive control unit which determines a compensation vector on the basis of an adaptive algorithm to minimize the expectation value of the product of the inner product between said input signal and said vector signal and an increment vector indicating the increment of said deviation in the order of time series, and which adds the compensation vector to an offset vector to be inputted, while being superposed on said input signal, to a circuit to output said vector sum.

3. An offset compensating device comprising:

a deviation monitor unit which creates a vector signal by A/D-converting the vector sum of the results of processings applied to two quadrature AC signals individually in response to an input signal and by quadrature-demodulating and which monitors the deviation of the DC components superposed on the vector signal; and

an adaptive control unit which updates the compensation vector determined in advance, on the basis of an adaptive algorithm to minimize the expectation value of the product of the sum of the inner product in a vector space between an increment vector indicating the increment of said deviation in the order of time series and the compensation vector, and the latest deviation vector indicating the deviation, and which adds the compensation vector to an offset vector to be inputted, while being superposed on said input signal, to a circuit to output said vector sum.

4. An offset compensating device comprising:

a deviation monitor unit which creates a vector signal by A/D-converting the vector sum of the results of processings applied to two quadrature AC signals individually in response to an input signal and by quadrature-demodulating and which monitors the deviation of the DC components superposed on the vector signal; and

an adaptive control unit which determines a compensation vector on the basis of an adaptive algorithm to minimize the expectation value of the product of the sum in a vector space between the inner product of said input signal and said vector signal and an increment vector indicating the increment of said deviation in the order of time series, and which adds the compensation vector to an offset vector to be inputted, while being superposed on said input signal, to a circuit to output said vector sum.

5. An offset compensating device comprising:

a deviation monitor unit which creates a vector signal by A/D-converting the vector

sum of the results of processings applied to two quadrature AC signals individually in response to an input signal and by quadrature-demodulating and which monitors the deviation of the DC components superposed on the vector signal; and

an adaptive control unit which subtracts from said vector signal the inner product  
5 between an increment vector indicating the increment of said deviation in the order of time series and the compensation vector determined in advance, which updates the compensation vector on the basis of an adaptive algorithm to minimize the expectation value of the latest deviation vector indicating the deviation, and which adds the compensation vector to an offset vector to be inputted, while being superposed on said input signal, to a circuit to  
10 output said vector sum.

6. An offset compensating device comprising:

a deviation monitor unit which creates a vector signal by A/D-converting the vector sum of the results of processings applied to two quadrature AC signals individually in response to an input signal and by quadrature-demodulating and which monitors the  
15 deviation of the DC components superposed on the vector signal; and

an adaptive control unit which subtracts the inner product between said input signal and said vector signal from said vector signal, which updates the compensation vector on the basis of an adaptive algorithm to minimize the expectation value of the latest deviation vector indicating the deviation, and which adds the compensation vector to an offset vector to be  
20 inputted, while being superposed on said input signal, to a circuit to output said vector sum.

7. An offset compensating device according to any of Claims 1 to 6,

wherein said deviation monitor unit generates said vector signal by A/D-converting the result of processing applied to said vector sum and by performing a processing inverse to the processing in a digital area and then performing a quadrature-modulation.

8. An offset compensating device according to any of Claims 1 to 6,

wherein said adaptive control unit determines an inner product of two vectors which make a common angle with respect to all axes of the vector space in a quadrant in the vector space where the two vectors to be determined in their inner product are individually positioned and which have a common absolute value.

- 5     9.     An offset compensating device according to any of Claims 1 to 6,  
         wherein said adaptive control unit sets a step size  $\mu$  to be applied to said adaptive  
         control, to the larger value as said deviation is the larger.
10.     An offset compensating device according to any of Claims 1 to 5,  
         wherein said adaptive control unit sets a step size  $\mu$  to be applied to said adaptive  
10     control, to the larger value as said increment vector has the larger absolute value.
11.     An offset compensating device according to any of Claims 1 to 6,  
         wherein said deviation monitor unit smoothes said DC component the more over a  
         short section as the deviation determined in advance is the larger, thereby to obtain the  
         deviation as the result.
- 15     12.     An offset compensating device according to any of Claims 1 to 5,  
         wherein said deviation monitor unit smoothes said DC component the more over a  
         short section as the absolute value of said increment vector is the larger, thereby to obtain the  
         deviation as the result.
13.     An offset compensating device according to any of Claims 1 to 6,  
20     wherein said deviation monitor unit smoothes said DC component the more on the  
         basis of the weight having the larger changing rate to time series, as the deviation determined  
         in advance is the larger, thereby to obtain the deviation as the result.
14.     An offset compensating device according to any of Claims 1 to 5,  
         wherein said deviation monitor unit smoothes said DC component the more on the  
25     basis of the weight having the larger changing rate to time series, as the absolute value of

said increment vector is the larger, thereby to obtain the deviation as the result.

15. An offset compensating device according to any of Claims 1 to 6,

wherein said adaptive control unit acts intermittently at a frequency for said compensation vector to be updated.

5 16. An offset compensating device according to any of Claims 1 to 6,

wherein said adaptive control unit stops when the deviation determined in advance becomes lower than a predetermined lower limit.

17. An offset compensating device according to any of Claims 1 to 5,

10 wherein said adaptive control unit stops when the absolute value of said increment vector becomes lower than a predetermined lower limit.

18. An offset compensating device according to any of Claims 1 to 6, further comprising dispersion monitor unit which monitors the dispersion of the deviation determined in advance,

15 wherein said adaptive control unit stops when said dispersion becomes lower than a predetermined threshold value.

19. An offset compensating device according to any of Claims 1 to 5, further comprising; a dispersion monitor unit which monitors the dispersion of the absolute value of said increment vector,

20 wherein said adaptive control unit stops when said dispersion becomes lower than a predetermined threshold value.

20. An offset compensating device according to any of Claims 1 to 6,

wherein said deviation monitor unit monitors the deviation of said DC component with reference to the DC component superposed on said input signal.

21. An offset compensating device according to any of Claims 1 to 6, further comprising:

25 a quasi-offset monitor unit which detects the instant when the average of the DC

component superposed on said input signal becomes "0",

wherein said deviation monitor unit and said adaptive control unit start every time when said instant is detected by said quasi-offset monitor unit.

22. An offset compensating device according to any of Claims 1 to 6,

5 wherein said deviation monitor unit specifies the period for which the level of the component of said vector signal in a low range for the offset caused in said circuit to distribute is lower than a predetermined lower limit, and

wherein said adaptive control unit stops for the period specified by said deviation monitor unit.

10 23. An offset compensating device comprising:

a demodulator which generates two monitor signals by A/D-converting a modulated wave generated through two D/A converters individually corresponding to two quadrature channels and through a quadrature modulator arranged at the downstream stage of those D/A converters, and by quadrature-demodulating the converted wave;

15 an intermission control unit which intermits the feed of said modulated wave to said demodulator; and

a control unit which suppresses an imbalance of said quadrature modulator by extracting composite DC components individually contained in said two monitor signals for the period while said modulated wave is being fed, by extracting excess DC components individually contained in said two monitor signals for the period while said modulated wave is not fed, and by feeding back the difference for every said two channels between those composite DC components and excess DC components , individually to said two D/A converters.

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24. An offset compensating device comprising:

25 a demodulator which generates two monitor signals by frequency-converting,

A/D-converting and quadrature-demodulating a modulated wave generated through two D/A converters individually corresponding to two quadrature channels and through a quadrature modulator arranged at the downstream stage of those D/A converters;

a local-frequency control unit which sets the frequency of the local-frequency signal fed for said frequency conversion, at a predetermined value  $F$  and at a value  $(= F \pm \Delta f)$  different from the predetermined value  $F$ ; and

a control unit which suppresses an imbalance of said quadrature modulator by determining excess DC components individually contained in said two monitor signals for the period while the frequency of said local-frequency signal is different from said predetermined value  $F$ , by determining composite DC components individually contained in said two monitor signals for the period while the frequency of said local-frequency signal is at said predetermined value  $F$ , and by feeding back the difference for every said two channels between those composite DC components and excess DC components, individually to said two D/A converters.

25. An offset compensating device comprising:

a demodulator which generates two monitor signals by frequency-converting and A/D-converting a modulated wave generated through two D/A converters individually corresponding to two quadrature channels and through a quadrature modulator arranged at the downstream stage of those D/A converters, on the basis of the local-frequency signal of a frequency  $(= F \pm \Delta f)$  different from a predetermined value  $F$ , and by quadrature-demodulating the modulated wave on the basis of a carrier of the frequency  $(= f \pm \Delta f)$  different from the predetermined value  $f$ ; and

a control unit which suppresses an imbalance of said quadrature modulator, and by feeding back the DC components individually contained in said two monitor signals, individually to said two D/A converters.

26. An offset compensating device comprising:

a demodulator which generates two monitor signals by frequency-converting, A/D-converting and quadrature-demodulating a modulated wave generated through two D/A converters individually corresponding to two quadrature channels and through a quadrature modulator arranged at the downstream stage of those D/A converters;

a local-frequency control unit which sets the frequency of the local-frequency signal fed for said frequency conversion, at a predetermined value  $F$  and at a value  $(= F \pm \Delta f)$  different from the predetermined value  $F$ ; and

a control unit which suppresses an imbalance of said quadrature modulator by setting the frequency of the carrier to be fed to said quadrature-demodulation, to a frequency  $(= f \pm \Delta f)$  different from a predetermined value  $f$  for the period while the frequency of said local-frequency signal is different from said predetermined value  $F$ , by feeding back the DC components individually contained in said two monitor signals, to said two D/A converters, by setting the frequency of said carrier to said predetermined value  $f$ , and by feeding back said DC components to said two D/A converters.

27. An offset compensating device comprising:

a demodulator which generates two monitor signals by frequency-converting, A/D-converting and quadrature-demodulating a modulated wave generated through two D/A converters individually corresponding to two quadrature channels and through a quadrature modulator arranged at the downstream stage of those D/A converters;

a local-frequency control unit which sets the frequency of the local-frequency signal fed for said frequency conversion, sequentially at a value  $(= F \pm \Delta f)$  different from a predetermined value  $F$ , and at said predetermined value; and

a control unit which suppresses an imbalance of said quadrature modulator by setting the frequency of the carrier to be fed to said quadrature-demodulation, to a frequency



(=  $f \pm \Delta f$ ) different from a predetermined value  $f$  for the period while the frequency of said local-frequency signal is different from said predetermined value  $F$ , by feeding back the DC components individually contained in said two monitor signals, to said two D/A converters, by determining excess DC components as the difference between composite DC components individually contained in said two monitor signals while feeding back said DC components to said two D/A converters, when the frequency of said local-frequency signal becomes said predetermined value  $F$ , and by feeding back the difference for every said two channels between the composite DC components individually contained in the succeeding two monitor signals and said excess DC components, to said two D/A converters.

28. An offset compensating device according to any of Claims 24 to 27, further comprising:

a frequency control unit for keeping said value  $\Delta f$  is kept at  $(f_{\max} - f_c)$  or more or  $(f_{\min} - f_c)$  or less, for the maximum and minimum frequencies  $f_{\max}$  and  $f_{\min}$  of the occupied band of said modulated wave and for the frequency  $f_c$  of the carrier signal contained in said modulated wave due to said imbalance.